American Machinist

WC cuts cost of drilling composites

Applying a thin deposit of tungsten carbide to HSS twist drills reduced tool costs 94% in drilling a Space Age material

ADVANCED COMPOSITES are harsh on drills, as Rohr Industries (Riverside, Calif) discovered when it was using 172 HSS drills for every 1000 holes produced (5.8 holes/regrind) in Kevlar-aramid- and/or graphite-reinforced epoxy. But coating the drills with tungsten carbide increased the total number of holes produced per drill from 151 to 5200 and cut drill cost by 94%.

Rohr, a major components manufacturer for the aerospace industry, has been making engine packages for Boeing's 747 and 757 and the Douglas DC 980 for some time now. The cowls for these engines had been conventional assemblies of various aluminum and steel detail parts. To trim weight and facilitate assembly, traditional metals were replaced by composites. And this change permitted the cowls to be produced in two halves, which are installed by only drilling and bolting.

Drilling the material, however, proved far costlier than drilling the former metals. The multitude of holes, which range from 0.098 in. to 0.250 in. dia, necessitated resharpening the twist drills after every five or six holes. With 25 resharpenings per drill, drill cost came to almost $0.026 per hole, as shown in the table.

To prolong drill life, Rohr turned to "Rocklinizing" the drills, initially and after each resharpening. The process, developed and marketed by Rocklin Mfg (Sioux City, Iowa), electronically deposits tungsten carbide or titanium carbide on cutters and forming tools by means of a vibrating, arcing electrode produced by a hand-held gun powered by an electronic charge generator. Deposits range from 0.0001 in. to 0.004 in. or more and are controllable in 0.0001-in. increments by dial setting. About half of the coating impregnates the tool surface; an equal amount remains above the surface.

The metallurgy of the tool and geometry of the surface to be coated govern the size and type of electrode rod to be used and the main control setting. The lightly contacting point of the rod is gently and slowly swept over the wear surface to be treated, maintaining constant arcing contact and forming a visible deposit, by which the operator can readily judge when the coating is complete. Minimal practice is necessary to gain familiarity with the equipment and its method of application, and day-to-day use can be delegated to tool-crib personnel.

Three Rocklin equipment models, the 169, 500, and 600, provide maximum impregnation and build-up of 0.001 in., 0.002 in., and 0.004 in., respectively. Because build-up can be precisely controlled, the coatings can be applied to cutters after they have been sharpened and ground. Rohr contracts out the resharpening operation, then applies the coating in-house. On the twist drills, tungsten carbide is applied from the cutting surface down to about 1/16 in. into the flute. No subsequent touch-up is required.

The marked improvement in drill life and substantial attendant saving in drill cost for the cowls is indicated in the table. Note that just the initial coating on a new drill enables 200 holes to be drilled in the composite materials, 48 more than the uncoated drill can provide even after 25 resharpenings. Thus, this single treatment alone reduces drill cost per hole from $0.025 to $0.005. After 25 resharpenings and 25 recoating operations, drill cost per hole is reduced to $0.0016. With the company drilling 20,000-25,000 holes weekly for the various composite components it makes, drill cost per hole adds up to a substantial saving.

The success of this application encouraged Rohr to Rocklinize the Wiss shears and scissors used to cut composite plies. Here again, tool life has been increased significantly by the tungsten-carbide deposit. Prior to coating, these hand shears had to be resharpened every two weeks or so. Now they are usable for six months between treatments.

Model 169 sells for $1250. The 500 and 600, which replace the earlier 312 and 314, go for $2750 and $3500, respectively. These new models automatically trigger the gun when the electrode is in contact with the workpiece. The gun can also be triggered manually. Besides the cost savings from prolonged tool life, Rohr has realized additional savings from reduced downtime, setup time, and inspection time. Overall savings have more than justified equipment cost. ■—JAV

How coating drills with WC pays off

Former drill cost:	
Original drill cost	$0.85
Resharpening (25 times at $0.12 per operation)	$3.00
Cost per drill life	$3.85
Number of holes per drill life:	
1000/172 = 5.814 holes per resharpening	
26 × 5.814 = 151.163 holes/drill	
Drill cost per hole ($3.85/151.163)	$0.02547
Estimated drill cost with Rocklinizing:	
Original drill cost	$0.85
Rocklinize with WC electrodes (30 sec at $20.00/hr)	$0.1667
Net original cost	$1.0167
Drill cost per hole with original Rocklinizing:	
200 holes, 48.437 more holes than lifetime production by resharpened untreated drill ($1.0167/200)	$0.00508
Resharpened and re-Rocklinized drill:	
Net original cost	$1.0167
Resharpening (25 times at $0.12 per operation)	$3.00
Re-Rocklinize (25 times at $0.1667 per operation)	$4.1675
Net cost of resharpened and re-Rocklinized drill	$8.1842
Number of holes per drill life (200 x 26 = 5200)	
Drill cost per hole ($8.1842/5200)	$0.00157